Exploration of the Photosynthetic Parameters of American and Chinese Chestnuts

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Background

- American chestnuts (*Castanea dentata*) once made up 40-50% of the canopy cover throughout eastern forests of the US and Canada until invasive chestnut blight *(Cryphonectria parasitica)* destroyed 4 billion trees by the 1950's
- The American Chestnut Foundation (ACF) backcross breeding program was developed with goal of creating blight resistant American chestnut trees by breeding resistant Chinese chestnuts (*C. mollissima*) with susceptible American chestnuts
- Plant species differ in physiological parameters related to photosynthesis and these are associated with differences in growth rates

Objectives

- Measure photosynthetic parameters across a variety of light levels to compare photosynthetic parameters among pure Chinese chestnut and pure American chestnut trees
  - A_{sat} = Light-saturated net photosynthetic rate
  - Phi = Quantum yield

Methodology

- Study conducted in the American Chestnut Foundation Regional Seed Orchard at Eastern Kentucky University in Richmond, KY
- Created light response curves (Fig 1) for pure Chinese (n=9) and pure American (n=8) trees using the Li-6800 portable photosynthesis system
- Modeled data using equation from Prioul and Chartier (1977, Equation 6 in Lobo et al. 2013)
- Data fitted to model using R package onls and AQ_curve_function.R and diagnostic_AQ_plot_function.R by Nick Tomeo

Results and Discussion

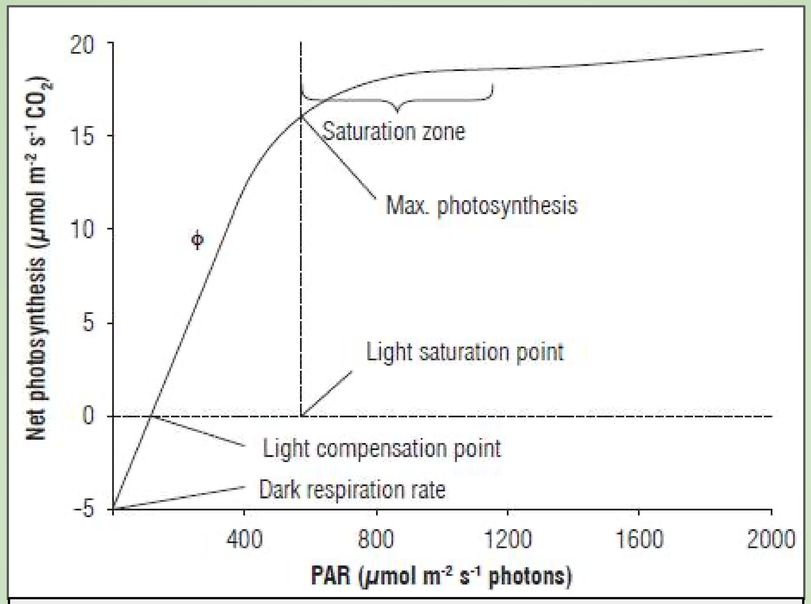

Figure1. A typical light response curve and the photosynthetic parameters derived from these data.

- American trees have higher A_sat values than Chinese trees on average (Fig. 2, $t_8 = 2.79$, $p = 0.024$).

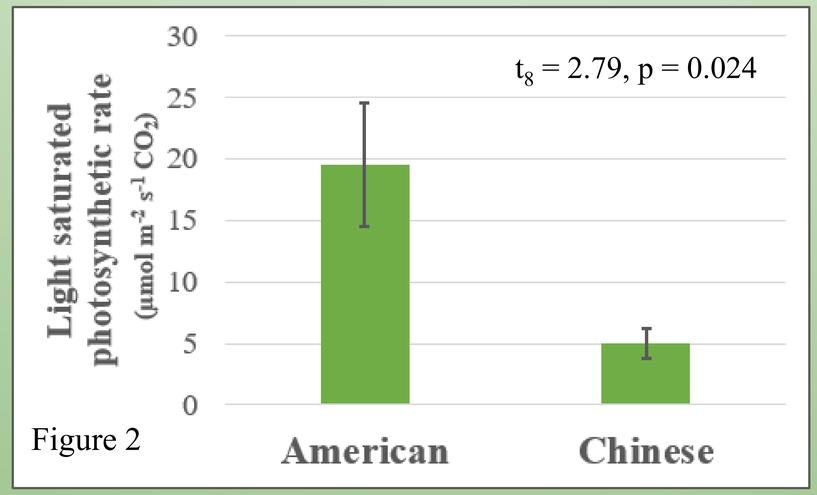

Figure 2

- There is no difference in Phi between the American and Chinese trees (Fig. 3, $t_7 = 0.71$, $p = 0.712$).

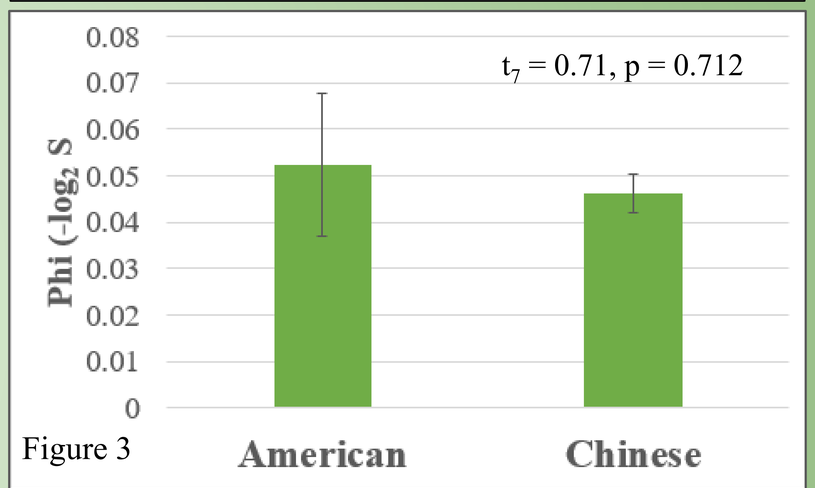

Figure 3

- We suggest that absent the blight, American chestnuts would outcompete Chinese chestnuts in a high light environment. American chestnuts are known to persist in low light conditions, but compete well in high light conditions. Chinese chestnuts don't get as large as Americans and may lack leaf adaptations to high light conditions.
- We could improve this study by including a comparison of hybrid chestnut trees, comparing the photosynthetic parameters before/after/during drought, and examining other parameters such as the light compensation point and the dark respiration rate.

Acknowledgements

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